absorption spectra, they uncovered a linear relation between the absorption intensity and the CO_2 concentration. The experimental data was reproducible to within an accuracy of 1%. As ambient air has a CO_2 concentration of around 0.03%, this detection accuracy is sufficient for CO_2 sequestration monitoring. *NH*

SENSORS

Rock-fall warning

J. Eur. Opt. Soc. Rapid Publ. **7,** 12048 (2012)

Rock falls are a major hazard in mountainous areas. Fortunately, it is possible to predict collapses by monitoring acoustic emissions from internal cracks in rocks. Luca Schenato and co-workers from the National Research Council of Italy, Vrije Universiteit Amsterdam in the Netherlands, and the University of Padova in Italy have now proposed a fibre-optic sensor for use in such an application. The device consists of a microcantilever on top of a cylindrical silica ferrule. The ferrule houses a standard single-mode fibre, and the gap between the cantilever and the fibre end face behaves as a resonating vibration-sensitive Fabry–Pérot cavity. The researchers measured the effect of dropping a steel ball on a trachyte block by monitoring the temporal change in the signal and its power spectral density. The spectral response was dominated by a peak centred at 12.5 kHz, which was the resonance frequency of the cantilever. The signal decayed asymptotically to a background level after about 100 ms. The ferrule top cantilever sensor was sensitive to volume waves because it was completely inserted in the rock. *NH*

METAMATERIALS

Exploiting loss

Opt. Express **21,** A96–A110 (2013)

Metamaterials operating at frequency ranges in which the dielectric permittivity is close to zero have been discussed for use across a wide range of optical applications. Sean Molesky and colleagues from the University of Alberta in Canada, have now proposed methods for engineering thermally excited far-field electromagnetic radiation using epsilon-near-zero metamaterials. In the same paper, the researchers also introduce epsilon-near-pole metamaterials, where there selected wavelength is that corresponding to the resonance pole, rather than the wavelength that gives zero permittivity. The researchers showed that these concepts may be useful for high-temperature applications such as capturing lost thermal energy in photovoltaic and other energy-conversion devices. In particular, they claim that photovoltaic devices with metamaterial emitters near temperatures of 1,500 K may surpass the Shockley–Queisser efficiency limit of 41%. They propose two metamaterial structures that should be able to be fabricated using current technology. One structure consists of simple layers of metal and dielectric films, and the other is a two-dimensional array of metallic nanowires in a dielectric matrix. The main advantages of thermal emitters based on these metamaterials include omnidirectional thermal emission, narrowband emissivity and polarization insensitivity. Importantly, the epsilon-near-zero and epsilon-near-pole emitters also function in reverse as highly effective thin absorbers. *DP*

ULTRASHORT PHOTONICS

Zeptosecond timing

Phys. Rev. Lett. **109,** 263902 (2012)

Dane Laban and co-workers from Griffith University in Brisbane and the University of Melbourne have generated multiple extreme-ultraviolet pulses with time delays that can be controlled to resolutions better than 100 zs. The scheme relies on precisely placing two closely spaced gas jets, which act as successive extreme-ultraviolet sources via high-order harmonic generation when they are exposed to the focus of a beam of few-cycle infrared pulses. The concept exploits the Gouy phase shift, which occurs as light passes through a focus and can be used to alter both the electron recombination time and the photon emission time of the high-order harmonic generation process. The temporal delay between the pulses can be modified by varying the separation of the two gas jets. The researchers demonstrated time delays within one half of the driving laser's period; a feat they claim is impossible using current techniques. *DP*

OPTOMECHANICS

Enhanced cavities

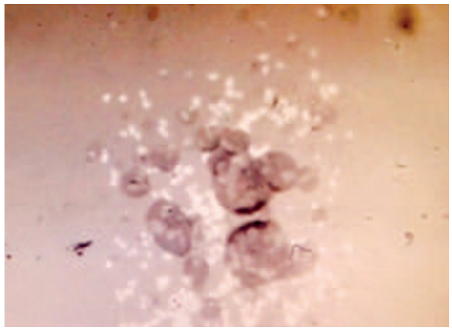
Phys. Rev. Lett. **110,** 037403 (2013)

The field of optomechanics, which is dedicated to coupling together light and vibrations (phonons), has become increasingly popular in recent years. Now, scientists in Argentina and France have fabricated vertical-pillar semiconductor cavities that they claim can greatly enhance the photon–phonon interaction due to strong confinement. Featuring multilayer (GaAs/AlGaAs) distributed Bragg reflectors at each end, the cavities reportedly have optical and acoustic *Q*-factors of ~10^3 and an optomechanical factor of several terahertz per nanometre. The researchers say that an optimized pillar cavity could potentially realize almost perfect sound extraction and thus open the way for the stimulated emission of phonons with threshold powers in the microwatt-to-milliwatt range and phonon lasing by parametric instability. *OG*

OPTOACOUSTIC LENS

Nanotube shock

Sci. Rep. **2,** 989 (2012)



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Intense, focused ultrasound is highly demanded for many applications in biomedical therapy and ablation treatment. Today's ultrasound technology relies on low-frequency piezoelectric transducers and can produce focal spots that are typically >2 mm wide and >10 mm long. Now, Hyoung Won Baac and co-workers from the University of Michigan in the USA have demonstrated a way to generate intense, high-frequency (>15 MHz) focused ultrasound. Their optoacoustic source exploits a nanocomposite film made of multiwalled carbon nanotubes (CNTs) and an elastomeric polymer formed on a 6-mm-diameter concave lens. Thanks to the high optical absorption of the CNTs and the efficient energy-conversion process of the CNT–polymer composite, the CNT-coated lenses directly enable acoustic focusing and generate an optoacoustic pressure of over 50 MPa in a tight focal spot measuring 75 μm × 400 μm. The team observed strong shock effects and non-thermal pulsed cavitation when using the lens. They then applied the approach to fragment solid materials and single-cell surgery, thus proving it to be a flexible, controllable and precise tool for the ultrasonic therapy of cells, blood vessels and tissues. *RW*

Written by Oliver Graydon, Noriaki Horiuchi, David Pile and Rachel Won.